Section 4.3
Equipping Your Function Toolkit

Curriculum Outcomes	Related Activities	Page in Text
• model real-world phenomena with linear, quadratic, exponential and power equations, and linear inequalities	• four connected investigations that will explore parameter changes in the graphs of functions • an introduction to the absolute value function is given for those students not familiar with the absolute value function	174,176, 178,180 183
• analyze and describe transformations of quadratic functions and apply them to absolute value functions • express transformations algebraically and with mapping rules • graph equations and inequalities and analyze graphs both with and without graphing technology • apply transformations when solving problems • use transformations to draw graphs		

Transformations

Transformations are a form of math where we are comparing two different graphs to see how they have moved. There are 4 different types of transformations that we will be talking about in this unit.

In order to compare graphs, we must first graph our equations.

Create a table of values (using the same values as seen below) and graph each of the following.

$y = x^2$

x	y
-3	9
-2	4
-1	
0	
1	
2	
3	

(-3,9)
(-2,4)

1. $y = x^2$

2. $y = -x^2$ ⟶ $-(-3)^2 = -9$

3. $y = x^2 + 3$

4. $y = x^2 - 6$

5. $y = 2x^2$

How to find the "y" in the table of values:

Example:

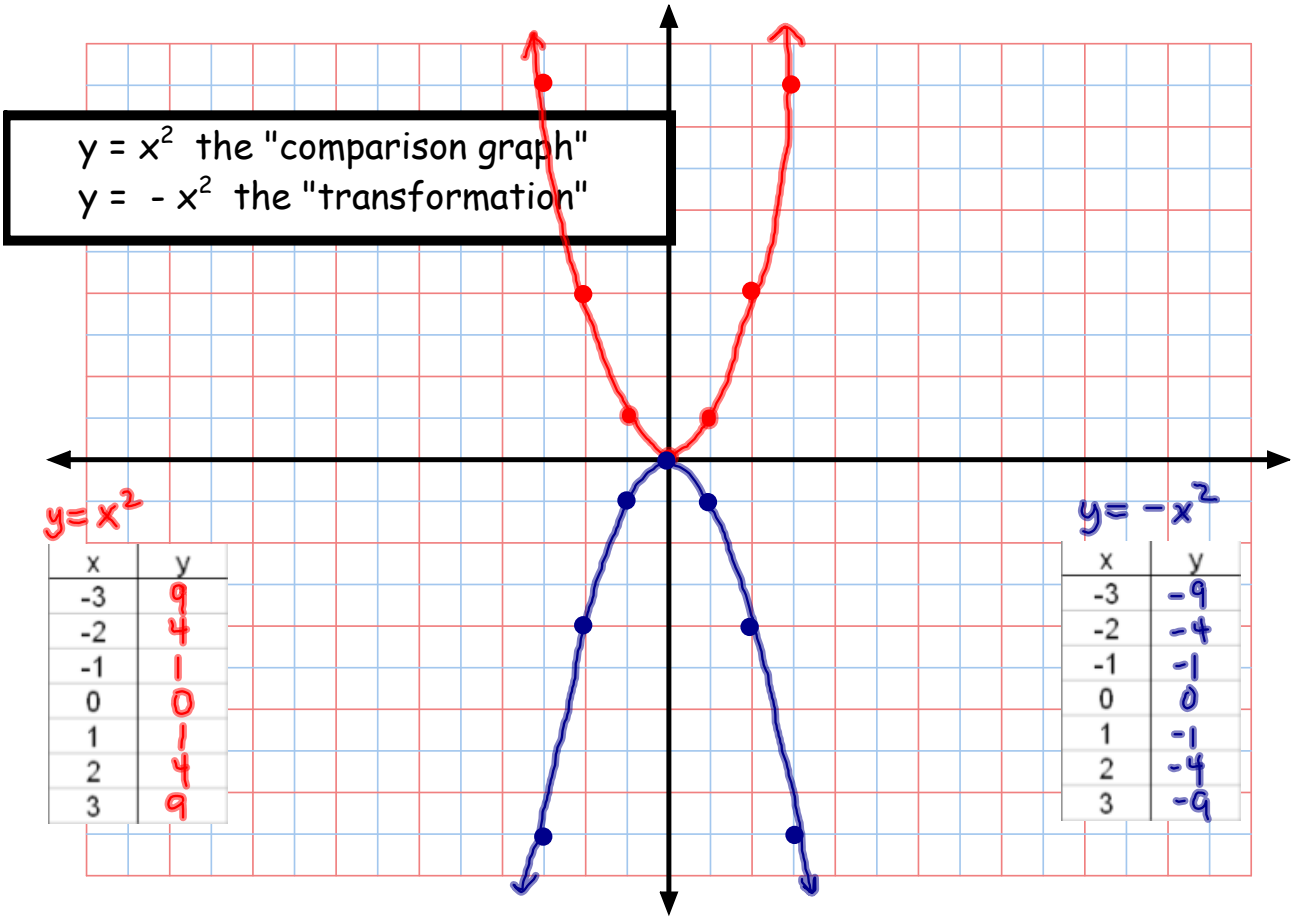
$y = x^2$
$y = (-3)^2$
$y = 9$

Using $y = x^2$

Your first point to plot will be (-3,9)

Compare each graph to the $y=x^2$ graph

- $y = -x^2$ ---> what changed?
- $y = x^2 + 3$ ---> what changed?
- $y = x^2 - 6$ ---> what changed?


y = x² the "comparison graph"
y = - x² the "transformation"
y= x²
x y
-3 9
-2 4
-1 1
0 0
1 1
2 4
3 9
y= -x²
x y
-3 -9
-2 -4
-1 -1
0 0
1 -1
2 -4
3 -9

$y = -x^2$

How do the 2 graphs compare?

We can describe how the 2 graphs compare verbally....

"Reflected" or "Flipped" over the x-axis.

And we can describe how the 2 graphs compare mathematically, using what we call "mapping notation"

$y = x^2$

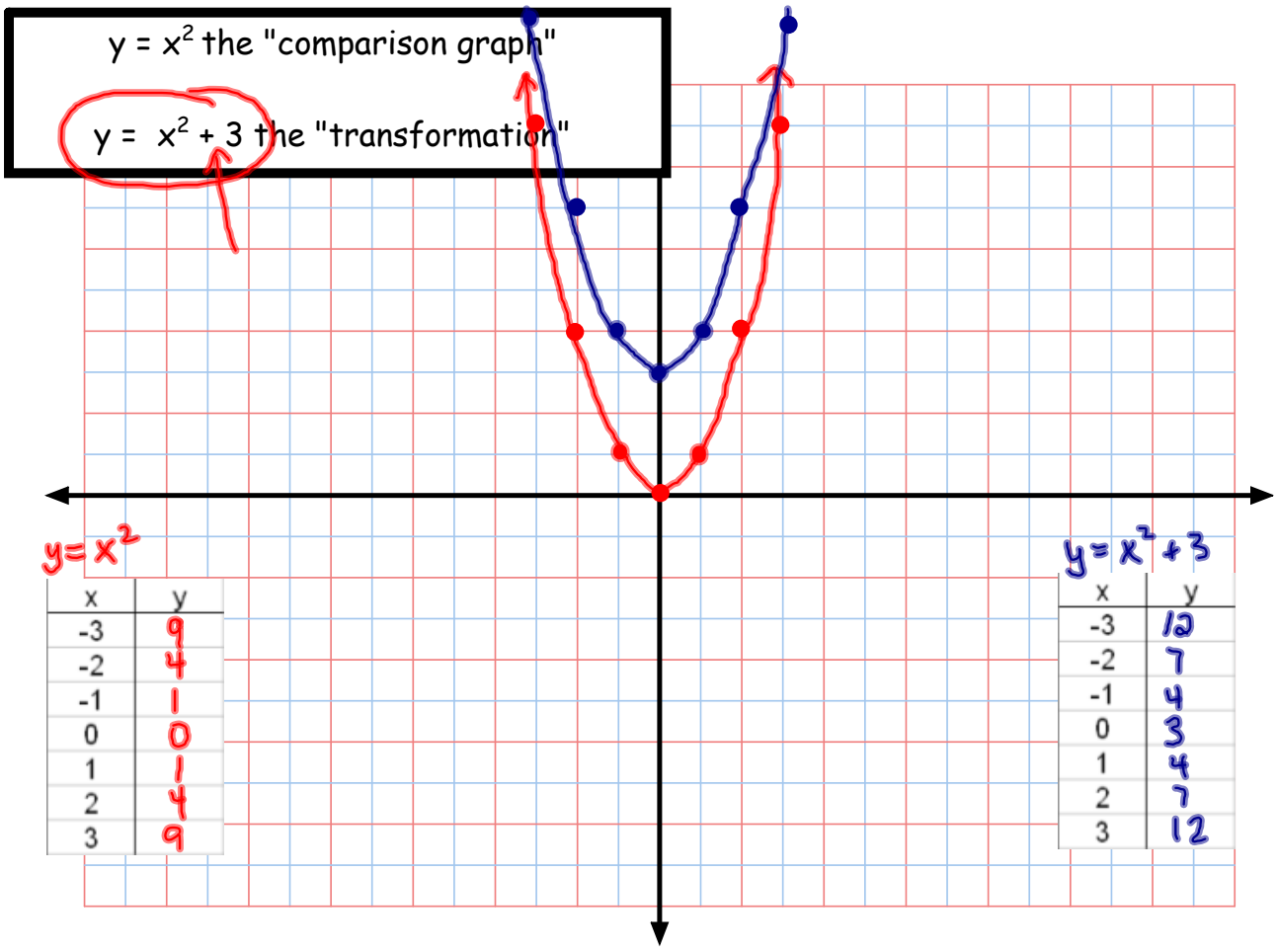
x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = -x^2$

x	y
-3	-9
-2	-4
-1	-1
0	0
1	-1
2	-4
3	-9

$(x, y) \longrightarrow (x, -y)$

Notice:
Each y-value was multiplied by a negative.


y = x² the "comparison graph"
y = x² + 3 the "transformation"
y=x²
x y
-3 9
-2 4
-1 1
0 0
1 1
2 4
3 9
y=x²+3
x y
-3 12
-2 7
-1 4
0 3
1 4
2 7
3 12

$y = x^2 + 3$

How do the 2 graphs compare?

We can describe how the 2 graphs compare verbally....

→ "Translation" or "slide" up 3 units

And we can describe how the 2 graphs compare mathematically, using what we call "mapping notation"

$y = x^2$

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = x^2 + 3$

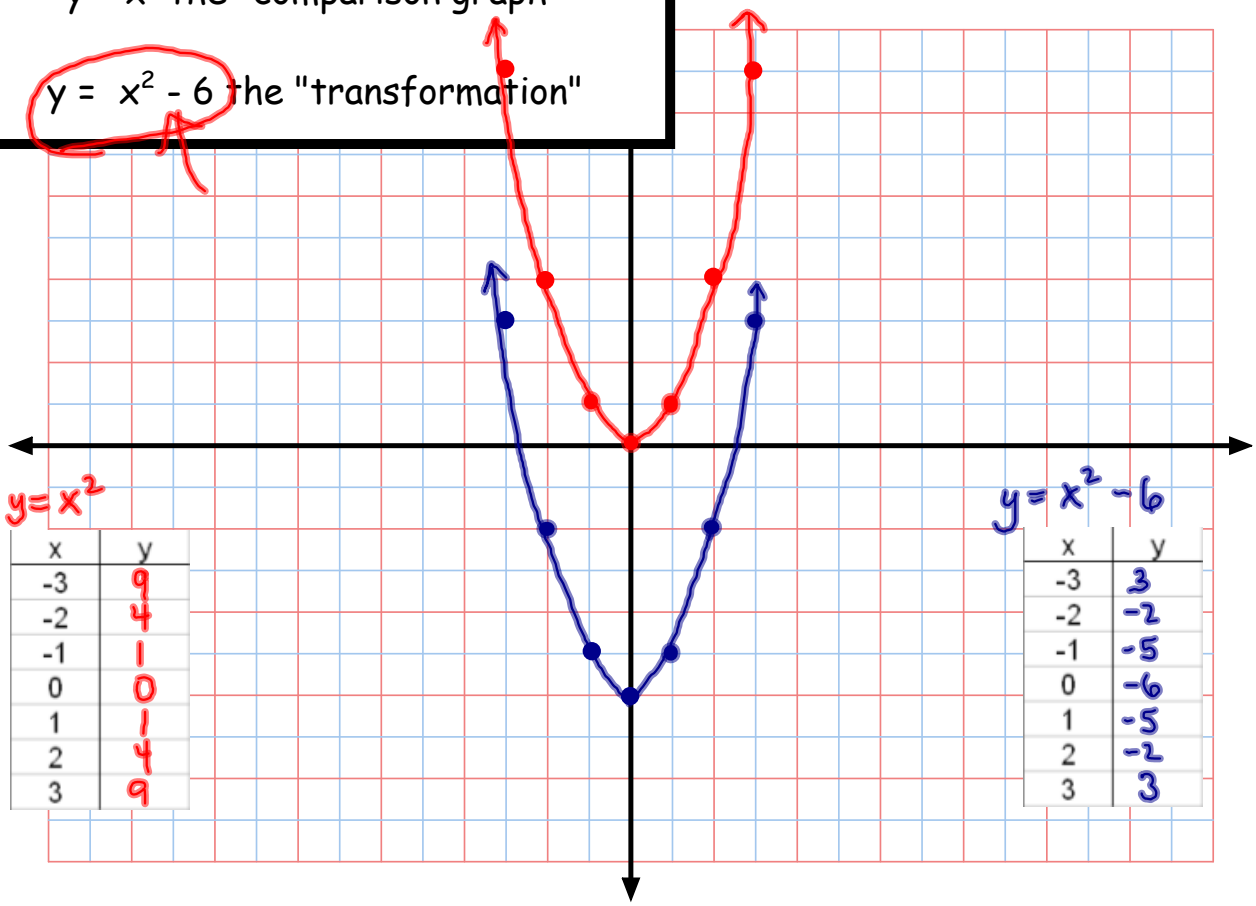
x	y
-3	12
-2	7
-1	4
0	3
1	4
2	7
3	12

Notice:
Each y-value had 3 added to it.

$(x, y) \longrightarrow (x, y + 3)$

$y = x^2$ the "comparison graph"

$y = x^2 - 6$ the "transformation"



$y = x^2$

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = x^2 - 6$

x	y
-3	3
-2	-2
-1	-5
0	-6
1	-5
2	-2
3	3

$y = x^2 - 6$

How do the 2 graphs compare?

We can describe how the 2 graphs compare verbally....

"Translation" or "slide" down 6 units

And we can describe how the 2 graphs compare mathematically, using what we call "mapping notation"

$y = x^2$

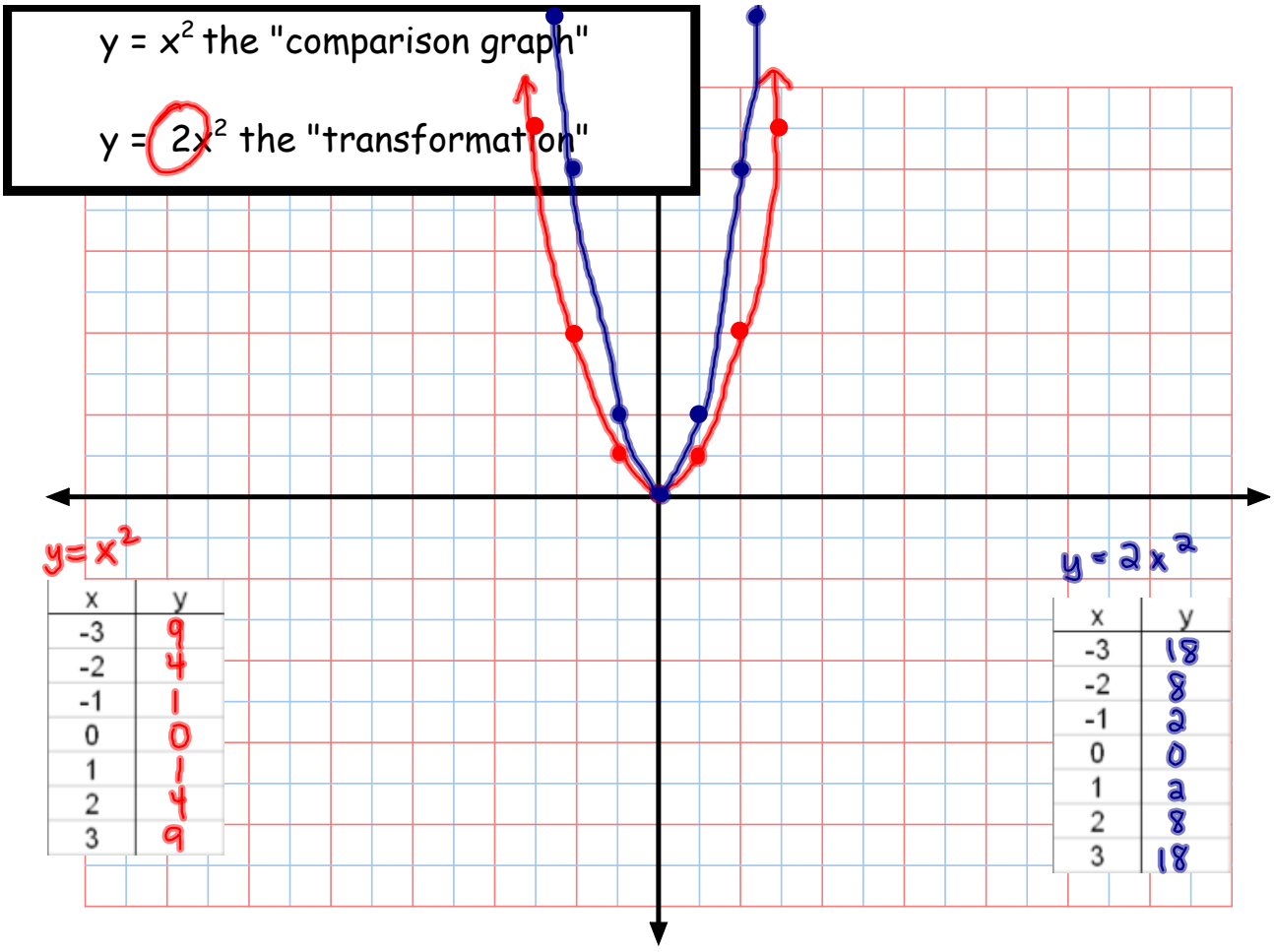
x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = x^2 - 6$

x	y
-3	3
-2	-2
-1	-5
0	-6
1	-5
2	-2
3	3

Notice: Each y-value had 6 subtracted from it.

$(x, y) \longrightarrow (x, y-6)$


y = x² the "comparison graph"
y = 2x² the "transformation"
y=x²
x y
-3 9
-2 4
-1 1
0 0
1 1
2 4
3 9
y=2x²
x y
-3 18
-2 8
-1 2
0 0
1 2
2 8
3 18

$y = 2x^2$

How do the 2 graphs compare?

We can describe how the 2 graphs compare verbally....

Vertical stretch of 2.
(2 times narrower)

And we can describe how the 2 graphs compare mathematically, using what we call "mapping notation"

$y = x^2$

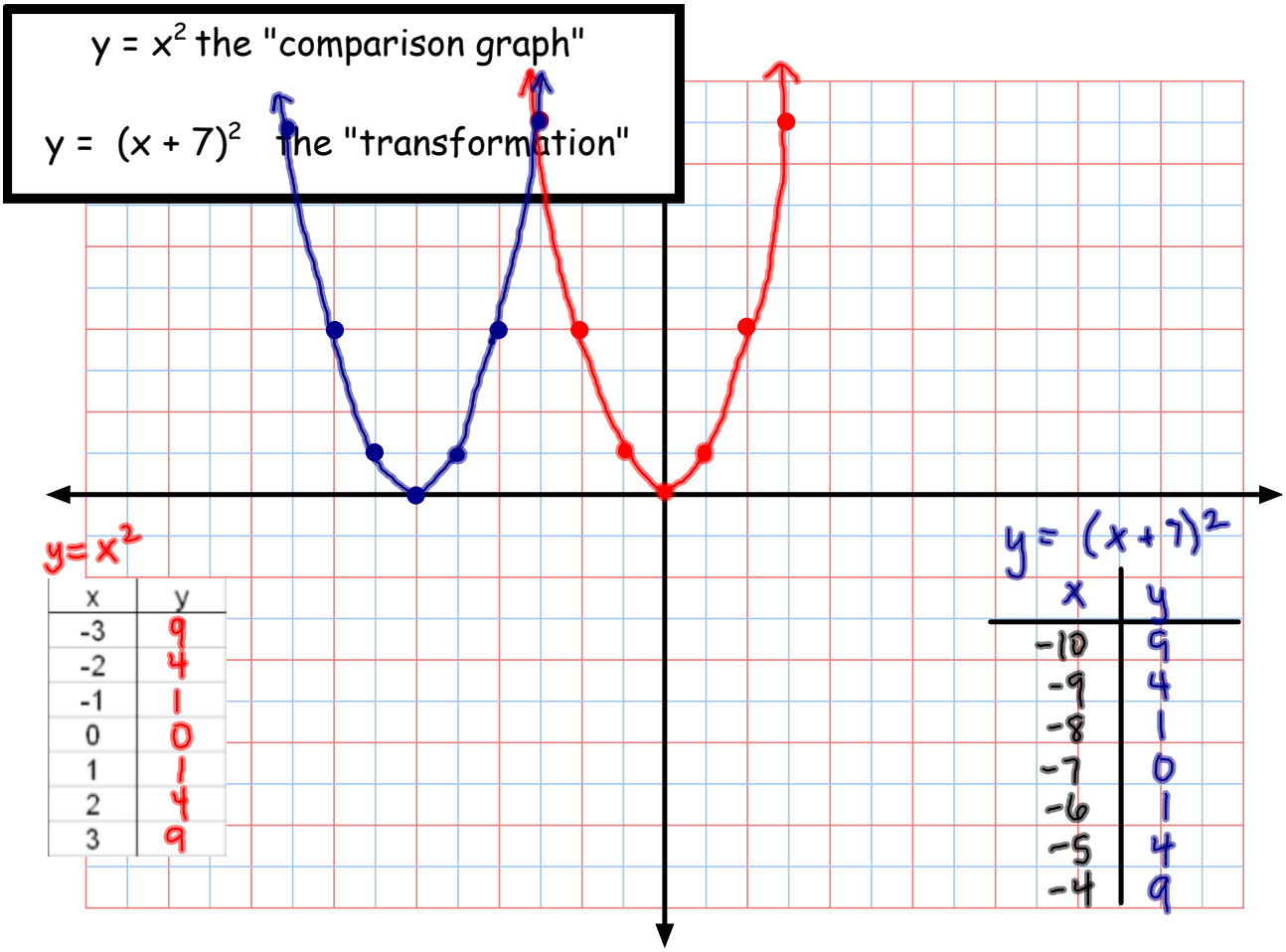
x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = 2x^2$

x	y
-3	18
-2	8
-1	2
0	0
1	2
2	8
3	18

Notice: Each y-value doubled.

$(x, y) \longrightarrow (x, 2y)$


y = x² the "comparison graph"
y = (x + 7)² the "transformation"
y=x²
x y
-3 9
-2 4
-1 1
0 0
1 1
2 4
3 9
y = (x+7)²
x y
-10 9
-9 4
-8 1
-7 0
-6 1
-5 4
-4 9

$y=(x+7)^2$

How do the 2 graphs compare?

We can describe how the 2 graphs compare verbally....

"Translation" or "slide" to the left 7 units

And we can describe how the 2 graphs compare mathematically, using what we call "mapping notation"

$y = x^2$

x	y
-3	9
-2	4
-1	1
0	0
1	1
2	4
3	9

$y = (x + 7)^2$

x	y
-10	9
-9	4
-8	1
-7	0
-6	1
-5	4
-4	9

$(x, y) \longrightarrow (x-7, y)$

Standard Form Vs. Transformational Form

The **standard form** of an equation is the form you are used to using

- it has y by itself

$y = -x^2$ $y = -x^2 - 1$ $y = x^2 + 8$

The **transformational form** of an equation is a form that has the x^2 by itself

$y = -x^2$ $y = -x^2 - 1$ $y = x^2 + 8$

If you are given an equation that is not in standard form, you will need to rearrange it so that it is.

This is necessary to create a table of values!

Copy & Complete the following table:

SF - Standard form Ref - Reflection VT - Vertical Translation
TF - Transformational form VS - Vertical Stretch HT - Horizontal Translation.

SF y=	TF $=x^2$	Ref (yes/no)	VS y/n	VT up/down	HT left/right	Mapping Notation (x,y)→(,)
$y=x^2 + 1$						
$y = x^2 + 4$						
$y = x^2 - 2$						
$y = -x^2 + 1$						
$y = -x^2 + 7$						
$y = x^2 - 6$						

Copy & Complete the following table:

SF	TF	Ref (yes/no)	VS	VT	HT	Mapping Notation
$y=(x + 3)^2$						
$y = (x - 2)^2$						
$y = (x - 5)^2$						
$y = -(x + 6)^2$						
$y = -(x - 4)^2$						
$y = -(x - 5)^2$						

Classwork/Homework

Complete Investigation 3

- Part 1 (Pg.174)
  - -Complete the procedure
  - -Answer questions #1-3, 5
- Part 2 (Pg.176)
  - -Complete the procedure
  - -Answer questions #7,11
- Part 3 (Pg.178)
  - -Complete the procedure
  - -Answer question #15
- Part 4 (Pg.180)
  - -Complete the procedure
  - -Answer question #17